第 43 卷 第 4 期
2000 年 11 月

昆 虫 学 报
ACTA ENTOMOLOGICA SINICA

Vol.43, No.4
Nov., 2000

文章编号：0454-6296（2000）04-0421-08

A phylogenetic analysis of the family Caligonellidae (Acari: Prostigmata) with descriptions of two new species

FAN Qing-hai
(Department of Plant Protection, Fujian Agricultural University, Fuzhou 350002, China)

Abstract: The phylogenetic relationship of the family Caligonellidae Grandjean is studied. The homonym *Sinognathus* Fan and Li is replaced with *Paraneognathus*. The position of four species formerly belonging to the genus *Neognathus* is discussed. Two new species, *Caligonella tunica* sp. nov. and *Coptocheles shaowuensis* sp. nov. from Fujian are described.

Key words: Acari; Caligonellidae; phylogenetic analysis; new species; China

Introduction

Grandjean found the family Caligonellidae for the monotype genus *Caligoella*[1]. Baker and Warton thought it was a synonym of Raphignathidae[2]. Summers and Schlinger redefined this family according to the comparison between Caligonellidae and Raphignathidae[3]. Meyer and Ueckermann[4] provided a key to the known genera and described 13 species of difference genera.

Diagnosis: Ovoid, 300～600 long. Chelicerae fused forming a stylophore, on which arises a pair of looped peritremes. Palptibae claw developed, few reduced. Palptarsus with 4 individual terminal eupathidia. Body dorsum without shield or with a weakly sclerotised medial propodosomal shield. Eye and postocular present or absent. Dorsum with 11～12 pairs of setae. Lyriform fissure 4 pairs, 3 pairs on dorsum and 1 pair on venter. Coxae Ⅱ and Ⅲ separated. Genital and anal pores separated, with 1～3 pairs of genital setae. Leg tarsus with more than 2 pairs of tenent hairs. Male without individual genital pore, and the genital-anal pore dorsal terminal, the first pair of paraproctal setae peg-like. Number of solenidion on tarsi similar to female.

Mites in the family often live on tree bark, litter, soil, moss, storehouse and bird's nest, feeding on small arthropods, and worldwide distributed. In China, 5 species have been described recently. Type specimens are deposited in Department of Plant Protection, Fujian Agricultural University. Measurements are given in microns.

Phylogenetic analysis

Raphignathus from the family Raphignathidae is chosen as outgroup.

Characters and state transformations (Fig.1, Table 1).

Matrix (Table 2) and cladogram (Fig. 2).

Foundation item: The research was supported by the National Foundation of Natural Science of China (39600018)
Received: 1999-10-12; accepted: 1999-12-29

Table 1 Morphological characters and their state transformation

表 1 形态特征及其性状演化

Gnathosoma

1. Shape of cheliceral stylophore: Elongate and tapered, (0); recurved, (1). 0→1
2. Situation of the start points of peritremes: Arising from the base of stylophore, (0); arising from the middle of stylophore, (1); arising from the front margin of stylophore, (2).

$$\begin{array}{c} 0\rightarrow 1 \\ \downarrow \\ 2 \end{array}$$

3. Situation of peritremes: Simple, end between stylophore and propodosoma, (0); go along the base and lateral margins of stylophore and terminate medially, (1); go directly to the base of stylophore, terminate on the outer margins of stylophore, (2); looped transversely to the lateral margins then curved internally, terminate on the outer margins of stylophore, (3); not reach to the base of stylophore, (4).

$$\begin{array}{ccccc} & & 4 & & \\ & & \uparrow & & \\ 1 & \leftarrow & 0 & \rightarrow & 2\rightarrow 3 \end{array}$$

4. Situation of palptarsal solenidion: At basal part of palptarsus, (0); at distal part of palptarsus, (1). 0→1
5. Condition of palptibial claw: Small, (0); big (1). 0→1
6. Number of ventral setae on subcapitulum: 2 pairs, (0); 1 pair, (1). 0→1

Dorsum

7. Condition of eye: Present, (0); absent, (1). 0→1
8. Position of posterior vertical setae *ve*: Situate on shield, (0); situate on membrane, (1). 0→1
9. Position of setae c_2 to *sce*: Inner, (0); outer, (1). 0→1
10. Position of lyriform fissure *ia*: Far from eye or *sce*, (0); close to eye, (1). 0→1
11. Condition of medial propodosomal shield: Present, (0); absent, (1). 0→1
12. Number of anal setae: 3 pairs, (0); no more than 2 pairs, (1). 0→1

Venter

13. Condition of coxisternal shields: Absent, (0); present, (1). 0→1
14. Number of aggenital setae: 1 pair, (0); 2 pairs, (1); 3 pairs, (2). 0→1→2
15. Number of gential setae: 3 pairs, (0); 2 pairs, (1); 1 pair or absent, (2). 0→1→2

Legs

16. Number of solenidion on basal part of tarsus Ⅰ: 2 solenidion, (0); 1 solenidion, (1). 0→1
17. Situation of solenidia on tibae Ⅰ: 1, (0); 2 and distanced, (1); close, (2); adjacent, (3). 0→1→2→3
18. Condition of solenidion on genus Ⅱ: Present, (0); absent, (1). 0→1
19. Setation on trochanter Ⅲ: 2 setae, (0); 1 or 0, (1). 0→1
20. Tenent hairs on empodium of tarsus: At least 4 pairs, (0); less than 3 pairs, (1). 0→1

Table 2 Character matrix for outgroup and the genera of Caligonellidae

表 2 外群和小黑螨科各属性状状态矩阵

Taxa 分类单元	Characters 性状状态			
	00000	00001	11111	11112
	12345	67890	12345	67890
Raphignathus 缝颚螨属	00000	00000	00000	00000
Caligonella 小黑螨属	1240?	10101	?1?12	12111
Coptocheles 刺爪螨属	01301	00010	001?1	1?100
Molothrognathus 莫颚螨属	01211	10101	??012	13111
Neognathus 新颚螨属	01100	01110	11021	01000
Paraneognathus 副新颚螨属	00101	01110	10020	01000

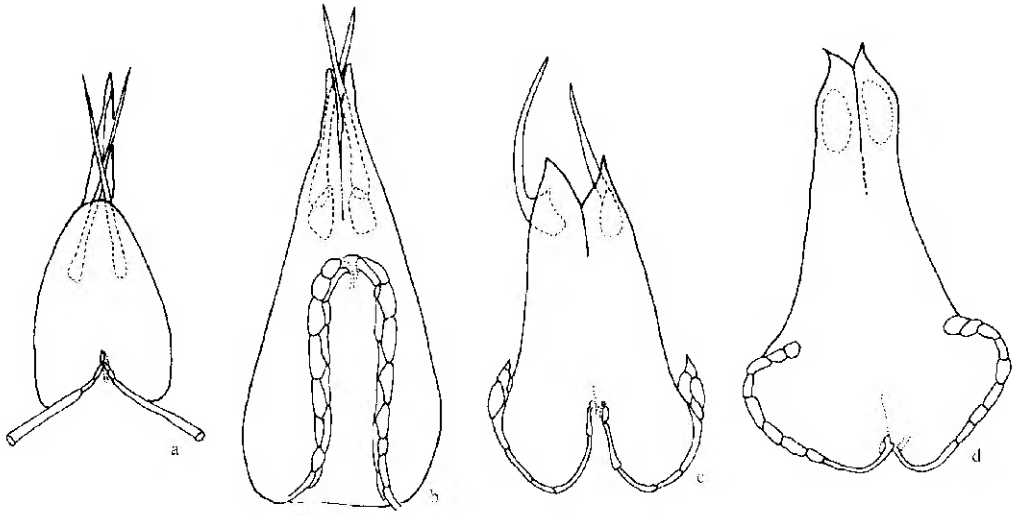

Fig. 1　Stylophores of some genera of Caligonellidae and *Raphignathus*

图 1　小黑螨科部分属和缝颚螨属口针鞘

a. *Raphignathus* sp.; b. *Molothrognathus* sp.; c. *Neognathus* sp.; d. *Paraneognathus* sp.

Program Hennig 86[5] was employed for cladistic analysis. Command mh* was used and result one tree (L=38, ci=78, ri=66) (Fig. 2).

Renaming of *Sinognathus* Fan and Li

Fan and Li[6] published a new genus *Sinognathus* without knowing that the name had been used for a reptilian by Young 1959[7]. Therefore, a new name *Paraneognathus* is provided to replace the homonym.

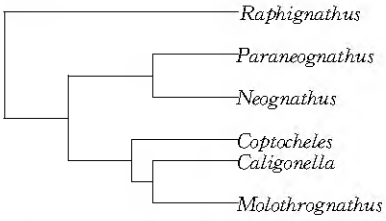

Fig. 2　Cladogram of relationship among Caligonellidae

图 2　小黑螨科支序关系

Discussion on four species of *Neognathus*

The following species belonging to *Neognathus*, *N. afrasiaticus* Soliman, *N. oblongus* Soliman, *N. summersi* Gerson and *N. vulsus* Chaudhri, Akbar and Rasool, possess curved peritremes ends, 3 pairs of genital setae in female and a tongue shaped flange on ventral surface of leg Ⅲ in male. It is suggested that these species be transferred to the genus *Paraneognathus*.

New Species

***Caligonella tunica* sp. nov.** (Fig. 3)

Female. Dark red in life. Length of idiosoma 330, width 188.

Gnathosoma, Stylophore 67 long. Palp 60 long, Counts of setae and solenidia on palpi (from trochanter to tarsus): 0—1—1—3 + 1 claw—3 + 1ω + 4 eupathidia. Tibial claw about one-third

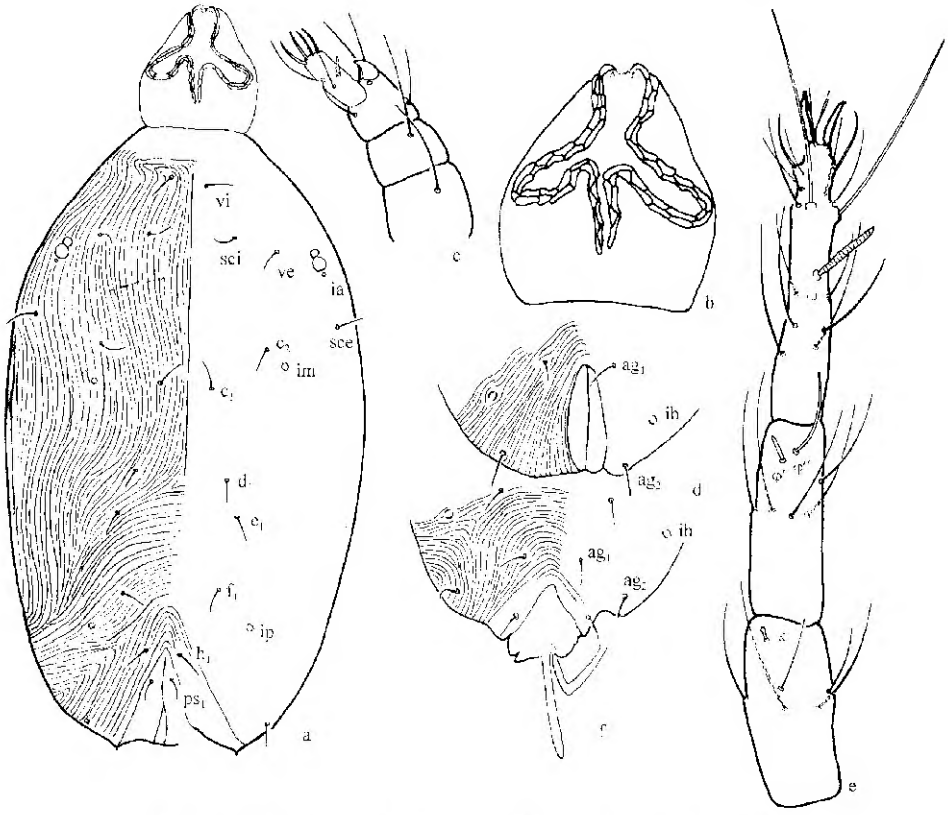

Fig.3 *Caligonella tunica* sp. nov. (a～e. female; f. male)

图3 柔小黑螨，新种（a～e. 雌螨；f. 雄螨）

a. dorsal view 背面观；b. stylophore 口针鞘；c. palp 须肢；d. aggenital area 殖肛区；e. leg Ⅰ 足Ⅰ；f. aggenital area and aedeagus 殖肛区和阳茎

the length of tarsus. The inner pair of adoral setae stout and spine-like. Base part of subcapitulum with a pair of simple setae, 28 long.

Dorsum. Without shield. Dorsal setae small. Ratio c_1—c_1 : d_1—d_1 : e_1—e_1 : f_1—f_1 = 1:1.9:2.4:1.9; Lengths of setae: *vi* 12, *ve* 14, *sci* 11, *sce* 17, c_1 13, c_2 13, d_1 13, e_1 13, f_1 13, h_1 11, h_2 10; distances between setae: *vi*—*vi* 21, *vi*—*sci* 37, *sci*—*sci* 40, *sci*—*ve* 23, *ve*—*sce* 49, c_1—c_1 27, d_1—d_1 50, e_1—e_1 64, f_1—f_1 51, h_1—h_1 10, h_1—h_2 39. Anal pore terminal, with 1 pair of setae, 12 long.

Venter. Without coxisternal shield. Ventral setae 3 pairs; the second pair twice the length of the third pair, 1*a* 26, 3*a* 36, 4*a* 17. Aggenital setae 3 pair, ag_1 15, ag_2 13, ag_3 9. Genital pore terminal, without genital setae.

Legs. Lengths of leg Ⅰ～Ⅳ: 237, 186, 192, 227. Each tarsus bears one solenidion ω. Tibia Ⅰ bear 2 solenidia. Counts of setae and solenidia on legs Ⅰ～Ⅳ: coxae 1*a* + 2—2—2—2, trochanters 1—1—1—1, femora 2—2—2—2, genua 5 + 1κ—5 + 1κ—2—2, tibae 5 + 2φ—5—

4—4，tarsi 15+1ω—11+1ω—9—9. Length of solenidia on tarsi: Ⅰω 13，Ⅱω 10. Ⅰφ″（17）about 3.4 times the length of Iφ′（5）. Solenidion κ on genus Ⅰ rod-like，with a spherical tip. Empodium of tarsi with 2 pairs of tenent hairs.

Male. Length of idiosoma 268，width 139.

Gnathosoma. Stylophore 64 long，palp 60 long. Counts of setae and solenidia on palpi same as female. Subcapitulum setae，23.

Dorsum. Without shield. Ratio of setae c_1—c_1:d_1—d_1:e_1—e_1:f_1—f_1=1:1.5:1.8:1.6. Lengths of setae vary from 10 to 14. Distances between setae: *vi*—*vi* 24，*vi*—*sci* 27，c_1—c_1 24，d_1—d_1 37，e_1—e_1 43，f_1—f_1 39，h_1—h_1 19.

Venter. The first and second pair of ventral setae about twice the length of the third pair，1*a* 23，3*a* 23，4*a* 12. Aggenital setae 3 pairs，lengths: ag_1 13，ag_2 10，ag_3 7. Genital-anal pore terminal，without genital seta. Aedeagus simple，club shaped.

Legs. Lengths of legs Ⅰ～Ⅳ: 196，147，165，188. Counts of setae and solenidia on legs Ⅰ～Ⅳ same as female. Length of solenidia on tarsi: Ⅰω 10，Ⅱω 8. Solenida on tibia Ⅰφ″（14）about 3.1 times the length of φ′（4.5）.

Etymology. This species is named for character of soft body.

Type materials. Holotype female，allotype male，ex moss，Pucheng，Fujian，17 July 1994，Fan，Q-H; 1 paratype female，ex moss，Ningde，Fujian，16 July 1994，Chen，Y-H.

Remarks. This species is closely related to *Caligonella humilis*（Koch，1838）[3]，but can be distinguished by outer solenidion φ″on tibae Ⅰ about 3.4 times the length of the inner solenidion φ′ and solenidion k on genus Ⅰ with a spherical tip.

***Coptocheles shaowuensis* sp. nov.**（Fig. 4）

Female. Bright red in life. Length of idiosoma 547，width 350.

Gnathosoma. Stylophore surface with fine punctulations，102 long. Movable digit claviform，38 long. Peritremes looped to the marginal area and form 2 circles at each side and their tips end beyond the margins of stylophore. Palptibae and palptarsi strong. Counts of setae and solenidia on palpi（from trochanter to tarsus）: 0—2—2—3+1 claw—4+1ω+1spine+3 eupathidia. Basal part of subcapitulum with 2 pairs of setae，about equal in length，32. The inner pair of adoral setae situates slightly behind the outer pair.

Dorsum. With a weakly sclerotised medial propodosomal shield and a pair of reduced lateral propodosomal shields. One pair of eyes and 1 pair of postocular bodies situated on the lateral propodosomal shields. Dorsal setae ensiform; ratio of setae c_1—c_1:d_1—d_1:e_1—e_1:f_1—f_1=1.2:1:1.7:1.4. Lengths of setae: *vi* 29，*ve* 30，*sci* 29，*sce* 30，c_1，c_2，d_1，e_1，f_1 28—29，h_1 36，h_2 35; distances between setae: *vi*—*vi* 43，*vi*—*sci* 40，*sci*—*sci* 68，*sci*—*ve* 48，*ve*—*sce* 43，c_1—c_1 87，c_1—d_1 74，d_1—d_1 74，d_1—e_1 77，e_1—e_1 128，e_1—f_1 64，f_1—f_1 100，h_1—h_1 41，h_1—h_2 26. Anal pore terminal，with 3 pairs of setae，ps_1 29，ps_2 28，ps_3 26.

Venter. Coxisternal shield scutated. The first pair of ventral setae 1*a* situate on coxae Ⅰ and

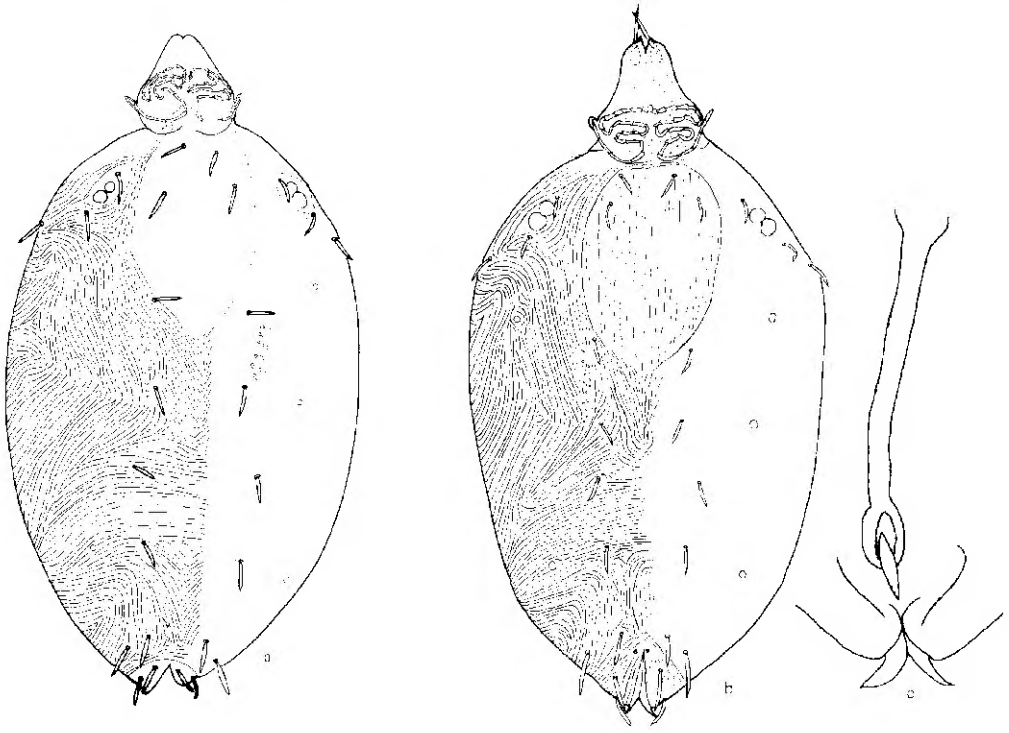

Fig. 4 *Coptocheles shaowuensis* sp. nov.

图4 邵武刺爪螨，新种

a. dorsal view of female 雌螨背面观；b. dorsal view of male 雄螨背面观；c. aedeagus of male 阳茎

the second pair $3a$ situate on endopodal shields between coxae Ⅲ. These setae about twice the length of the third pair, lengths $1a$ 63, $3a$ 62, $4a$ 30. Aggenital setae 1 pair, lengths 25. Genital pore terminal, with 2 pairs of setae around genital valves, about equal in length, 21.

Legs. Lengths of leg Ⅰ～Ⅳ: 433, 381, 371, 453. Each tarsus bears one solenidion ω. Solenidia on tibia Ⅰ φ' close to φ''. Counts of setae and solenidia on legs Ⅰ～Ⅳ: coxae $1a+2$—2—2—1, trochanters 1—1—2—1, femora 5—5—4—4, genua $5+1\kappa$—5—4—4, tibae $5+2\varphi$—$5+1\varphi$—$4+1\varphi$—$4+1\varphi$, tarsi $20+1\omega$—$18+1\omega$—12—12. Length of solenidia on tarsi Ⅰω 9, Ⅱω 8. Solenidia on tibae Ⅰφ'' (14) about 2.3 times the length of Ⅰ$\varphi\rho'$ (6). Solenidion κ on genus Ⅰ rodlike with bifid tip. Empodium of each tarsus has 2 row and at least 8 pairs of tenent hairs.

Male. Length of idiosoma 371, width 237.

Gnathosoma. Stylophore 82 long. Movable digit, 35 long. Counts of setae and solenidia on palpi same as female. Setae on subcapitulum about equal in length, 28.

Dorsum. Situation of dorsal shield, eyes and postocular bodies similar to female. Ratio of setae c_1—c_1:d_1—d_1:e_1—e_1:f_1—f_1 = 1.2:1:1.3:1. Lengths of setae: *vi* 20, *ve* 20, *sci* 21, *sce* 20, c_1, c_2, d_1, e_1, h_1 19—20, h_2 30; distances between setae: *vi*—*vi* 36, *vi*—*sci*

20，c_1—c_1 64，c_1—d_1 63，d_1—d_1 53，d_1—e_1 40，e_1—e_1 66，e_1—f_1 38，f_1—f_1 53，h_1—h_1 27，h_1—h_2 25. Genital-anal pore terminal，with only 3 pairs of paraproctal setae，ps_1 very small，peg-like，ps_1 3，ps_2 26，ps_3 24.

Venter. The first and second pairs of ventral setae about 2.7 times of the third pair，lengths $1a$ 48，$3a$ 50，$4a$ 18. Aggenital setae 1 pair，lengths 19.

Legs. Lengths of leg Ⅰ～Ⅳ：310，270，264，283. Counts of setae and solenidia similar to female except femora（4—4—3—3）and tarsi（18＋1ω—16＋1ω—10—10）. Length of solenidia on tarsi：Ⅰω 8，Ⅱω 8. Solenidia of tibae Ⅰφ″（11）about 2.1 times the length of Ⅰφ′（5）.

Deutonymph. Length of idiosoma 434，widith 313.

Gnathosoma. Stylophore 92 long. Movable digit，38 long. Counts of setae and solenidia on palpi as in female. Subcapitulum setae 2 pair，about equal in length，32.

Dorsum. Dorsal shield，eyes and postocular bodies similar to female. Lengths of setae vary from 21 to 25. Anal pore terminal，with 3 pairs of setae，ps_1 28，ps_2 26，ps_3 20.

Venter. Ventral setae，$1a$ 58，$3a$ 61，$4a$ 18. Aggenital setae 1 pair，lengths 20. Genital pore and genital setae absent.

Legs. Lengths of leg Ⅰ～Ⅳ：361，309，209，360. Counts of setae and solenidia similar to female except femora（4—4—3—3）and tarsi（18＋1ω—16＋1ω—10—10）.

Etymology. This species is named for the place where it was collected.

Type materials. Holotype female，allotype male，2 paratype females，4 paratype males and 1 deutonymph，ex moss，Shaowu，Fujian，4 November 1995，Chen G-M.

Remarks. This species resembles *Coptocheles grandjeani* Robaux[8]，but can be distinguished by palptarsi have 4＋1ω＋3 eupathidia，with 18 setae on tarsus Ⅱ and the shape of body setae.

Acknowledgment　The author sincerely thanks Prof. Chao Hsiufu，Biological Control Institute，Fujian Agriculatural University，Prof. Wang Huifu，Institute of Zoology，Academia Sinica，for their enthusiastic guidance and also thanks Dr. Jin Daochao who helped me in the computer program analysis.

References　（参考文献）

[1] Grandjean F. Observations sur les acariens de la famille des Stigmaeidae. Archives des Sciences Physiques et Naturelles，1944，26：103～131

[2] Baker E W，Warton G W. An introduction to Acarology. New York Macmillan，Co. 1952. 1～465

[3] Summers F M，Schlinger E I. Mites of the family Caligonellidae（Acarina）. Hilgaridia，1955，23(12)：539～561

[4] Meyer M K P(Smith)，Ueckermann E A. African Raphignathoidea(Acari：Prostigmata). Entomology Memoir Department of Agriculture and Water Supply，Republic of South Africa，1989，74：1～58

[5] Farris J S. HENNIG86 reference，version 1.5 computer program and documentation. 1988

[6] Fan Q H，Li L S. A new genus and a new species of caligonellid associated with food from China. Acta Zootaxonomica Sinica，1995，20(3)：323～327

[7] Romer A S. Vertebrate paleontology. 3rd edition. University of Chicago Press. Chicago & London. 1966
[8] Robaux P. Observations sur quelques Actinedida(=Prostigmates)du sol d'Amerique du nord. I. Une nouvelle espece de Caligonellidae(Acari-Raphignathoidea): *Coptocheles grandjeani* n. sp. Acarologia, 1975, 17(2): 236~242

小黑螨科系统发育关系分析及二新种描述
（蜱螨亚纲：前气门目）

范青海
（福建农业大学植保系，福州 350002）

摘要：利用形态特征分析了小黑螨科已知5个属的系统发育关系。对异物同名 *Sinognathus* Fan and Li（华颚螨属）重新命名为 *Paraneognathus*（副新颚螨属）。讨论了原来归在新颚螨属 *Neognathus* 的4个种的分类地位。描述了柔小黑螨 *Caligonella tunica* sp. nov. 和邵武刺爪螨 *Coptocheles shaowuensis* sp. nov. 二新种。模式标本存放于福建农业大学植保系。

关键词：蜱螨亚纲；小黑螨科；系统发育分析；新种；中国
中图分类号：Q969.91 **文献标识码**：A